Thoracic Cage

* Formation of the thoracic cage:

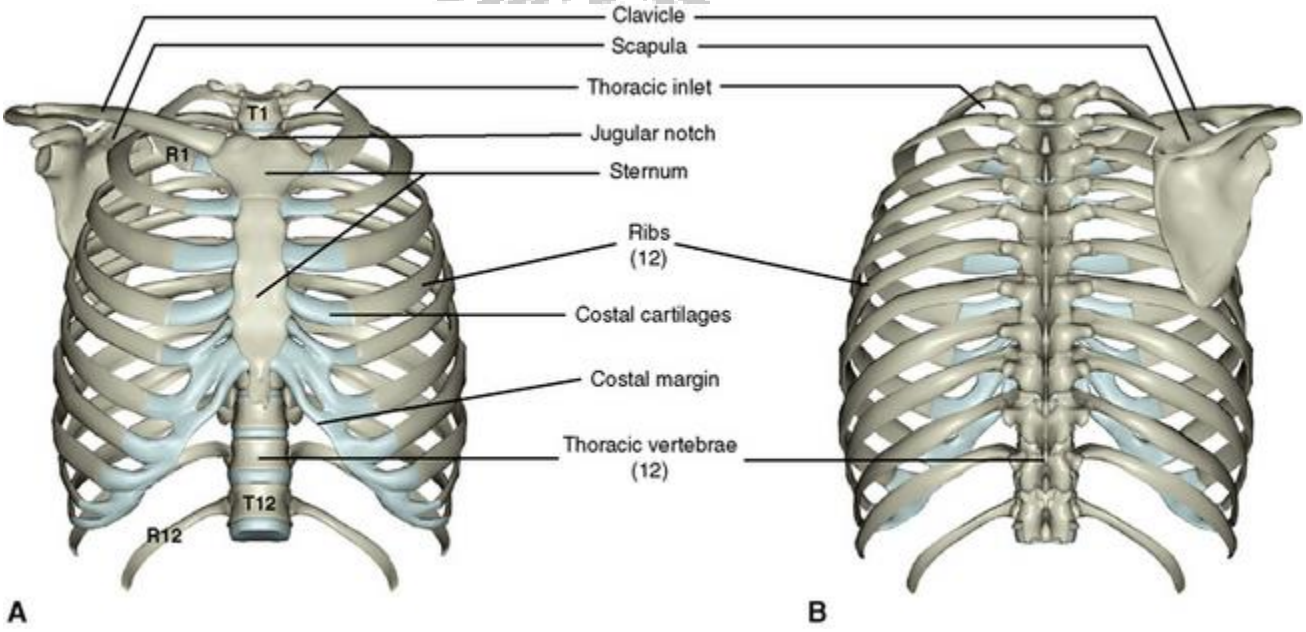
- Sternum and costal cartilages..... in front
- Thoracic vertebrae, intervertebral discs and ribs..... behind
- Twelve pairs of ribs, mainly the shaft.....on each side

* Functions of the thoracic cage:

- Supports and protects thoracic and upper abdominal viscera.
- Shares in movements of respiration.

* The thoracic cavity has:

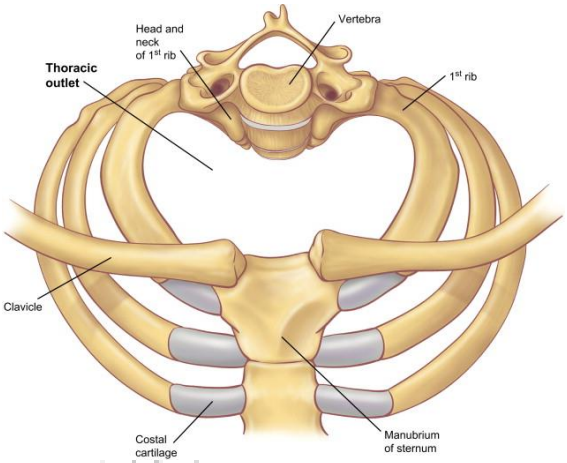
- An inlet: narrow, continuous with the root of the neck.
- A cavity: encloses the constituents of the thorax e.g. lungs and heart.
- An outlet: broad, closed by diaphragm which separates it from abdominal cavity.



Thoracic inlet

* Boundaries:

- Upper border of manubrium sterni……in front
- Body of 1st thoracic vertebra……behind
- Inner border of 1st rib ……on each side

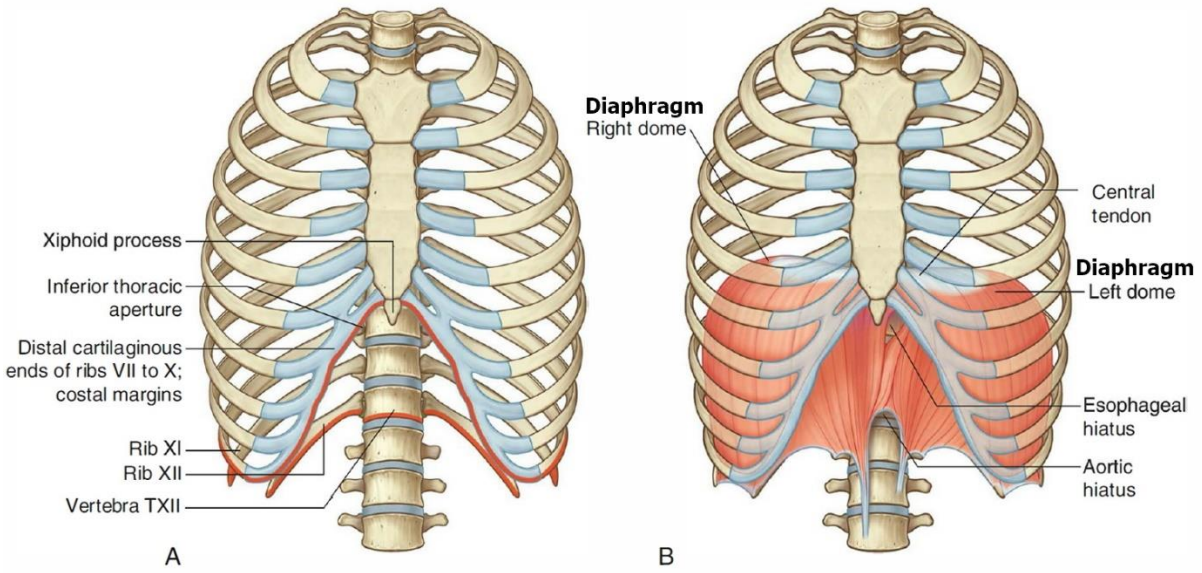


Thoracic outlet

It is sloping downwards and backwards. It is closed by the diaphragm

* Boundaries:

- Xiphoid process……in front.
- Body of T12 vertebra and 11th and 12th pairs of ribs…… behind.
- Costal cartilages of 7th, 8th, 9th and 10th ribs…… on each side.



Intercostal Muscles

Arranged in 3 layers from superficial to deep:

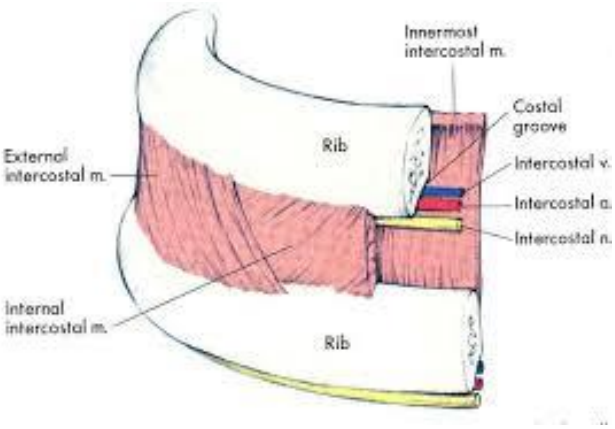
- External intercostal muscle.

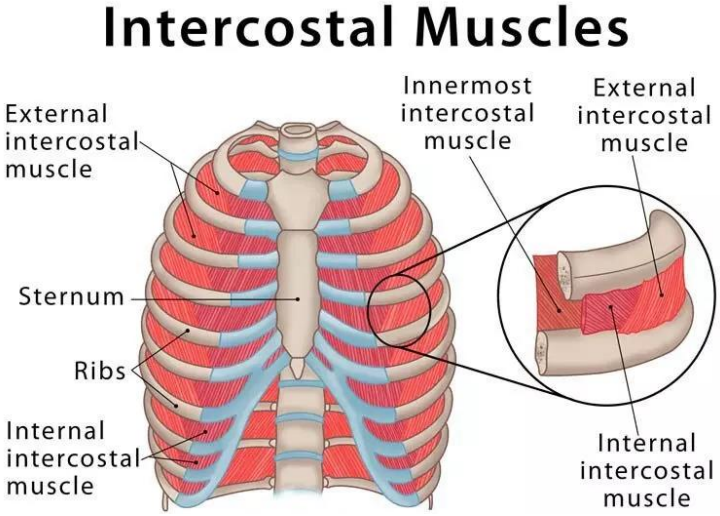
-Internal intercostal muscle.

-Transversus thoracis muscle: it's an incomplete layer which is formed of 3 separate muscles

from before backwards: sternocostalis, innermost intercostal and subcostalis

Feature	External Intercostal	Internal Intercostal	Innermost Intercostal
Origin	Lower border of rib above	Floor of costal groove of rib above	Upper lip of costal groove of rib above
Insertion	Upper border of rib below	Upper border of rib below	Upper border of rib below
Direction of fibers	Obliquely downwards and forwards	Obliquely downwards and backwards	Same as internal intercostal
Extent	From tubercle posteriorly to costochondral junction anteriorly (continues as anterior intercostal membrane)	From sternum anteriorly to angle of rib posteriorly (continues as posterior intercostal membrane)	From midaxillary line anteriorly to angle of rib posteriorly

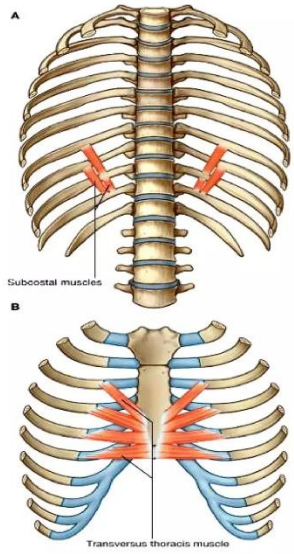




Comparison between Sternocostalis and Subcostalis Muscles

	Sternocostalis Muscle	Subcostalis Muscle
Extent	4–5 slips on inner surface of upper part of anterior thoracic wall.	Numerous slips on inner surface of lower part of posterior thoracic wall.
Origin	Back of lower 1/2 of body of sternum.	Posterior part of rib, medial to its angle.
Direction of Fibres	Upward & laterally.	Downward & medially (crossing 1–2 ribs).
Insertion	2nd to 6th costal cartilages.	Upper border of 2nd or 3rd rib below.
Nerve Supply	By corresponding intercostal nerve and its collateral branch.	By corresponding intercostal nerve and its collateral branch.
Action	Supports the sternocostal joints.	Supports the costotransverse joints.

Subcostalis and Sternocostalis



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- **Nerve supply of intercostal muscles:**
  corresponding intercostal nerve and its collateral branch.

- **Action of intercostal muscles:**

1- elevators of the ribs (inspiratory).
and depressors of the ribs (expiratory muscles).

2- prevent the intercostal spaces from
being sucked inwards during inspiration or puffed outwards during expiration.

Neuro-Vascular Bundle

- Each neurovascular bundle is formed of the intercostal nerve and vessels. The 3 structures occupy the costal groove of the rib, lying between the internal and innermost intercostal muscles.
- They are arranged from above downwards as VAN i.e. the intercostal vein is uppermost, then the artery while the intercostal nerve is lowermost.
- There are twelve thoracic nerves and vessels on each side. But, as there are only 11 spaces, the structures in these spaces are considered intercostal.
- The neurovascular bundle along the lower border of last rib contains 12th thoracic nerve (T12) and 12th vessels; they are called subcostal nerve and vessels.
- There are 12 thoracic spinal nerves.

The Intercostal (and Subcostal) Nerves

- Nerves of special characteristics:

- The 1st nerve: most of its fibers ascend to join the brachial plexus.

- The 12th (subcostal) nerve: runs its whole course in the abdominal wall.

- Typical intercostal nerves: from the 2nd to the 6th nerves; they run their whole course in the thoracic wall.

- Non-typical intercostal nerves: from the 7th to the 11th nerves; they run part of their course in the thoracic wall and part in the abdominal wall.

• Typical Intercostal Nerves

anterior 1ry rami of the thoracic spinal nerves from the 2nd to the 6th.

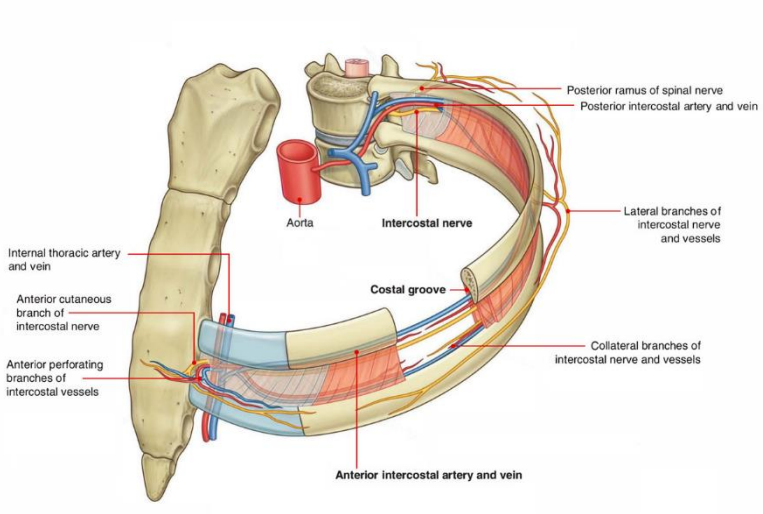
• Course and Relations:

In the posterior part :

The nerve comes from the intervertebral foramen and runs laterally behind the sympathetic chain. it lies between the parietal pleura (in front) and the posterior intercostal membrane (behind).

In the costal groove :

the nerve runs in the neurovascular plane between the internal intercostal muscle (to the outside) and the innermost intercostal muscle (to the inside).


Posterior ramus of spinal nerve
Posterior intercostal artery and vein
Aorta
Intercostal nerve
Lateral branches of intercostal nerve and vessels
Internal thoracic artery and vein
Costal groove
Anterior cutaneous branch of intercostal nerve
Collateral branches of intercostal nerve and vessels
Anterior perforating branches of intercostal vessels
Anterior intercostal artery and vein

In the anterior part of the intercostal space

: The nerve runs between the internal intercostal muscle and parietal pleura. lateral to the sternum, it turns forwards piercing internal intercostal muscle, anterior intercostal membrane and pectoralis major

END: in the skin as the anterior cutaneous branch.

- **Branches and Distribution: چاپر کان معاه کتاب اناتومی پراکتیکال**

1- Ganglionic branches: each nerve is connected to corresponding sympathetic ganglion by 2 rami communicantes, white and grey.

2- Collateral branch: runs along the upper border of the rib below; it supplies the intercostal muscles.

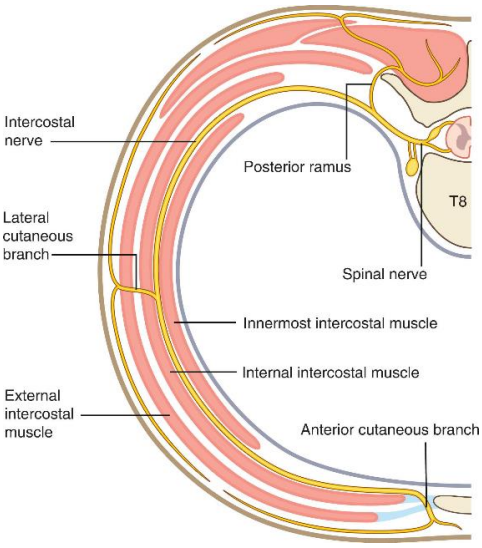
3- Muscular branches: supply the intercostal muscles.

4- Lateral Cutaneous branch: It supply skin over front and side of thorax.

5- Anterior Cutaneous branch: supply skin front of thorax.

6- Articular branches: to the joints of the ribs.

7- Pleural branches: to the adjacent parts of the parietal pleura.



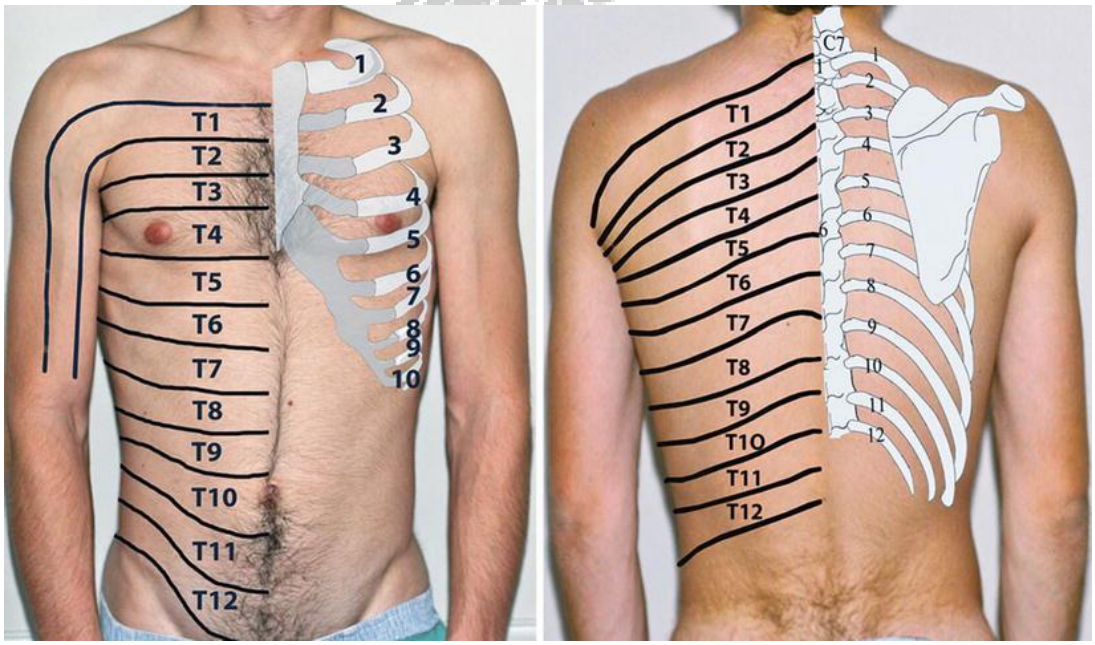
- ***2nd Intercostal Nerve:***

It resembles the typical intercostal nerve but its lateral cutaneous branch does not divide into anterior and posterior divisions. Instead, it crosses the axilla to the upper limb where it supplies skin over the floor of the axilla and the upper 1/2 of the medial side of the arm. It is called the intercostobrachial nerve

.

Cutaneous Innervation (dermatomes) of Thoracic wall

- The skin of the thoracic wall above the level of the sternal angle is supplied by C3,4 via supraclavicular nerves. Below that level, it is supplied by thoracic nerves (starting from T2) via lateral and anterior cutaneous branches of intercostal nerves (mainly the typical).**The *missing nerves between C4 and T2* (*C5,6,7,8 and T1*) are drawn with limb bud forming the *brachial plexus which supplies U.L.***
- Each intercostal nerve supplies an oblique band of skin. The skin over the xiphoid process, for example, is supplied by T6 (it lies opposite T9 vertebra). The lower 5 intercostal nerves and the subcostal nerve extend into the abdominal wall.
- The skin of the posterior thoracic wall is supplied by the cutaneous branches of the posterior 1ry rami of thoracic nerves.

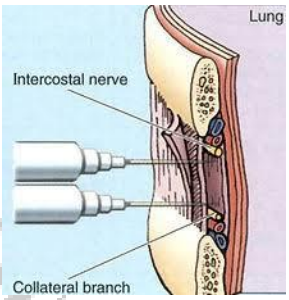


Applied Anatomy:

1- Irritation of the intercostal nerve:

A lesion involving an intercostal nerve causes severe referred pain at its cutaneous distribution i.e. areas supplied by its lateral or anterior cutaneous branches.

2- Intercostal nerve block:



Injection of local anesthesia around the intercostal nerve can relive root pain. There is minimal overlap between the intercostal nerves.

3- Pus from the region of vertebral column:

Follows the course of the neurovascular bundle and may appear at any of the 3 sites of exit of the cutaneous branches of the thoracic nerve:

- Lateral to sacrospinalis (posterior 1ry ramus).
- In midaxillary line (lateral branch).
- Lateral to sternum (anterior branch).

4- Infection with herpes zoster virus:

The intercostal nerves may be infected by a virus called herpes zoster; severe burning sensation and a red strip of skin with small vesicles appear along the course of the affected nerve.